Available online at www.sciencedirect.com

ScienceDirect

Procedia Computer Science 92 (2016) 175 – 180

Procedia Computer Science

2nd International Conference on Intelligent Computing, Communication & Convergence

(ICCC-2016)

Srikanta Patnaik, Editor in Chief

Conference Organized by Interscience Institute of Management and Technology

Bhubaneswar, Odisha, India

A Neuro-fuzzy based model for analysis of an ECG signal using Wavelet Packet Tree

Sakuntala Mahapatra[a*], Debasis Mohanta[b], Prasant Mohanty[c], Santanu kumar Nayak[d], Pranab kumar Behari[e]

[ace] *Dept of ETC, Trident Academy of Technology, Bhubaneswar, BPUT, Odisha,751020, India*
[bd] *Dept of Electronic Science, Berhampur University, Berhampur, Odisha, 760007, India*

Abstract

Detection and classification of electrocardiogram (ECG) signals are critically linked to the diagnosis abnormalities. Any abnormality in the wave shape and duration of the wave features of the ECG is considered as arrhythmia. This paper presents a diagnostic system for classification of cardiac arrhythmia from ECG data, using hybrid model of Artificial Neural Network and Fuzzy Logic. In an ECG, clinically useful information is obtained from the intervals and amplitudes of the cardiac waves. In an ECG, the non-stationary signal commonly changed its statistical property with time. In the proposed paper an algorithm based on wavelet packet tree classifier (for detection of QRS complex) has been implemented for the comparative study of automatic real-time ECG data. The amplitude and duration of the characteristic waves of the ECG can be more accurately obtained using Wavelet Packet Tree (WPT) analysis. WPT techniques have been employed to extract a set of linear (time and frequency domain) characteristics. Neuro-fuzzy techniques have been employed to extract a set of non-linear characteristic features from the transformed ECG signals. The real-time signals are obtained from various diagnostic centers. The hybrid model of Wavelet Packet Tree and Neuro-fuzzy network is proposed for the analysis and comparative study of an ECG signal.

Peer-review under responsibility of the Organizing Committee of ICCC 2016

Keywords:-Electrocardiogram (ECG), Wavelet Transform (WT), Neuro-Fuzzy model. Feature extraction

* Corresponding author. *E-mail address:*mahapatra.sakuntala@gmail.com

Peer-review under responsibility of the Organizing Committee of ICCC 2016
doi:10.1016/j.procs.2016.07.343

1. Introduction

The electrocardiogram (ECG) signal is a biomedical signal which is used in the diagnosis system to detect the abnormal electrical activity of the heart.. ECG is a biomedical signal responsible for monitoring the state of the heart. It is also responsible for diagnosis of the abnormalities. It is a record of the wave passage that is generated by the heart muscles on repolarization and depolarization of the arteries and ventricles. The potential in the heart tissues is conducted to the body surface where it is measured using electrodes. The original data from the different time intervals such as PR, ST, QT intervals as shown in the figure (1). Here P wave shows the contraction interval of the arteries. QRS complex represent equivalent portion to the contraction of the ventricles and T wave is the relaxation of ventricles.

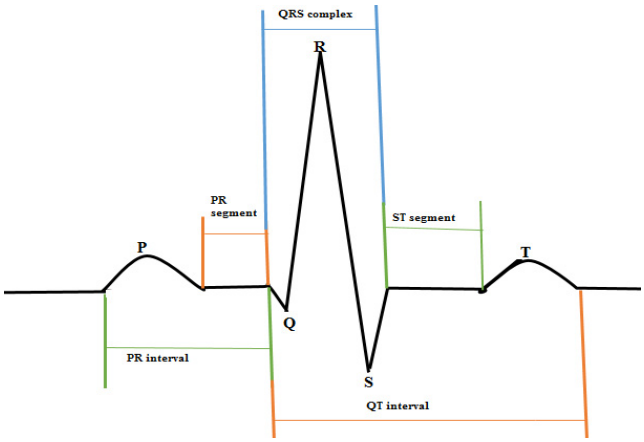

Fig. 1. ECG signal

The Electrocardiogram signal is widely utilized as the most important tool to study the heart state. The electrical activity of the human heart may be slower, faster or irregular than the normal signal results in case of cardiac arrhythmia. The ECG signals are non-stationary in nature, so the disorder of the heart may not appear at all times. For accurate diagnosis the ECG signal may be observed for disparate hours. This results in a high number of inputted data and the analysis turns out to be annoying and time consuming. Due to a long volume of data, the probability of an analyst to loss data is high. Hence there is a necessity in the diagnosis system to differentiate between the normal and abnormal signals. This helps the cardiologist for easy detection of the arrhythmia. Different intelligent systems have been developed for the analysis of the ECG signal. Here an algorithm has been used to detect the various classification problems. The main research related to ECG arrhythmias classification is the betterment of the performance of Neuro-fuzzy based classification by the application of Wavelet Transform (WT).

For the accurate analysis of an ECG signal, feature extraction is very important to detect the characteristics point and the different time intervals that can be used to detect possible cardiac abnormalities. Most of the times, the ECG signal is either corrupted or covered by noise. Wavelet analysis plays a very important role for the proper classification of the ECG signals as compared to other methods[5]. Wavelet Transform (WT) has the property of Multi-scale Approximation Analysis (MSA) to provide both time and frequency domain information of the signal. The techniques of Wavelet Transform (WT) that have been used to observe the signal decomposition into a set of some primary functions are called wavelet. They are obtained from a single prototype wavelet by dilations, contraction and shift.

2. Proposed Model

Arrhythmia detection algorithm consists of following steps

(a) Preprocessing of the ECG signal

(b) Processing or features extraction

(c) Classification of the features of ECG Signal

Figure (2) shows the block diagram of the whole algorithm of the proposed model. The system is based on Wavelet Transform and Neuro-fuzzy network.